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Date: July 24, 2000

Docket No.: 1131-0444P

Assistant Commissioner for Patents
Box PATENT APPLICATION
Washington, D.C. 20231

Sir:

Transmitted herewith for filing is the patent application of

Inventor(s): CLARKE, Paul
CHARLTON, John; ATOBE, Ichiro
TOKIDA, Atsushi

For: FILTER FOR A CIGARETTE AND A FILTER-TIPPED CIGARETTE

Enclosed are:

- ☒ X A specification consisting of 21 pages
- ☒ X 6 sheet(s) of Formal drawings
- ☒ X An assignment of the invention
- ☒ X Certified copy of Priority Document(s)
- ☒ X Executed Declaration ☒ X Original ☐ Photocopy
- ☐ A verified statement to establish small entity status under 37 CFR 1.9 and 37 CFR 1.27
- ☒ X Preliminary Amendment
- ☐ Information Disclosure Statement, PTO-1449 and reference(s)

Other

The filing fee has been calculated as shown below:

LARGE ENTITY				SMALL ENTITY	
FOR	NO. FILED	NO. EXTRA	RATE	FEE	
BASIC FEE	*****	*****	****		****
	*****	*****	****	\$690.00	****
	*****	*****	****		\$345.00
TOTAL CLAIMS	20 - 20 =	0	x18 = \$	0.00	x 9 = \$ 0.00
INDEPENDENT	5 - 3 =	2	x78 = \$	156.00	x 39 = \$ 0.00
MULTIPLE DEPENDENT CLAIM PRESENTED <u>no</u>			+260 = \$	0.00	+130 = \$ 0.00
TOTAL \$				846.00	TOTAL \$ 0.00

X A check in the amount of \$ 886.00 to cover the filing fee and recording fee (if applicable) is enclosed.

Please charge Deposit Account No. 02-2448 in the amount of \$_____. A triplicate copy of this transmittal form is enclosed.

No fee is enclosed.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. 1.16 or under 37 C.F.R. 1.17; particularly, extension of time fees.

Respectfully submitted,

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Bý

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IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicant: CLARKE, Paul et al
Appl. No.: NEW Group: UNKNOWN
Filed: July 24, 2000 Examiner: UNKNOWN
For: FILTER FOR A CIGARETTE AND A FILTER-TIPPED
CIGARETTE

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, DC 20231

July 24, 2000

Sir:

The following preliminary amendments and remarks are respectfully submitted in connection with the above-identified application.

AMENDMENTS

IN THE CLAIMS:

Please amend the claims as follows:

CLAIM 3: Line 1, change "claim 1 or 2" to --claim 1--

CLAIM 4: Line 1, change "any preceding claim" to --claim 1--

CLAIM 5: Line 1, change "any preceding claim" to --claim 1--

CLAIM 8: Line 1, change "any one of claims 1 to 4" to
--claim 1--

CLAIM 11: Line 1, change "any one of claim 1 to 4" to

--claim 1--

CLAIM 12: Line 1, change "any one of claims 1 to 4" to

--claim 1--

CLAIM 14: Line 1, change "any preceding claim" to --claim 1--

CLAIM 15: Line 1, change "any preceding claim" to --claim 1--

CLAIM 16: Line 1, change "any preceding claim" to --claim 1--

REMARKS

The amendment to the claims is to delete multiple dependencies in order to place the application in better form prior to examination.

Entry of the present amendment and favorable action on the above-identified application are respectfully requested.


If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees

Docket No. 1131-0444P

required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17;
particularly, extension of time fees.

Respectfully submitted,

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By 
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(Rev. 04/19/2000)

DESCRIPTION

FILTER FOR A CIGARETTE AND A FILTER-TIPPED CIGARETTE

Technical Field

- 5 The present invention relates to a filter for a cigarette, and a filter-tipped cigarette using the filter.

Background Art

- 10 A cigarette filter is known which has a central axial extending passage therethrough, or which has a plurality of axially extending passages at or in the peripheral portion thereof.

- 15 In use, such a filter delivers part of the smoke of the cigarette directly to the smoker through the passage(s). This non-filtered smoke locally spreads in the smoker's mouth, and the smoker can therefore enjoy not only a mild smoking feeling but also the original aroma or flavor of the cigarette, provided that there is an appropriate ratio of the quantity of non-filtered smoke directly delivered to the smoker through the
20 passage(s) to that of filtered smoke delivered to the smoker through a filter material.

- This ratio of smoke quantities is greatly influenced by the size of the central passage (or the number and arrangement of the peripheral passages) and the axial air-flow resistance
25 of the filter material. It is therefore desirable to facilitate control of the this ratio. Especially, the quantity of non-filtered smoke directly delivered to the smoker is important for providing the original taste and aroma of the cigarette to the smoker.

- 30 The non-filtered smoke in the passage(s) may be diluted by ventilation air introduced from outside to give a milder smoke. However, it is difficult to introduce such ventilation air into a central passage. In a filter having passages located

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at or close to the outer peripheral surface of the filter, ventilation air from outside can be introduced directly into the passages. In this filter, however, the direct introduction of the ventilation air is apt to alter extremely the axial
5 air-flow resistance of the filter and to give a poor smoking result; it is difficult to control precisely the amount of ventilation air (and hence diluting ratio of the non-filtered smoke) whilst keeping the axial air-flow resistance of the filter within a desired range.

10 The first object of the present invention is to provide a filter for a cigarette and a filter-tipped cigarette which are appropriate for controlling the ratio of the quantity of non-filtered smoke to that of the filtered smoke and suitably deliver a taste and aroma of the cigarette. The second object
15 of the present invention is to provide a filter for a cigarette and a filter-tipped cigarette, which can keep the original taste and aroma of the cigarette and provide a milder smoke.

Disclosure of the Invention

20 The first object is achieved by a filter for a cigarette, comprising an assembly of: a cylindrical filtering core; a tubular filtering sheath surrounding said core; and, between said core and said sheath, passages spaced circumferentially around said core and extending continuously between open ends
25 at the two ends of the assembly.

When a filter-tipped cigarette using the filter is smoked, part of the smoke of the cigarette passes through the core and the sheath and subsequently is delivered to the smoker. The remaining part of the smoke is directly delivered to the smoker
30 through the axial passages. Since the passages are provided between the core and the sheath, non-filtered smoke can easily reach the smoker's palate. As a result, even a small quantity of non-filtered smoke enables the smoker to enjoy the original

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taste and aroma of the cigarette. In other words, the taste and aroma of the cigarette are neither too strong nor too mild, and the smoker can enjoy the aroma and the flavor of the cigarette satisfactorily.

- 5 It is preferable that the sheath has a thickness of 1 to 3 mm, the ratio of the core diameter to the thickness of the sheath is 0.7 to 6, and there are 3 to 25 passages.

- The axial air-flow resistance of the sheath may be different from that of the core, and the former is preferably
10 higher than the latter. In this case, the quantity of smoke flowing in the core is larger than that flowing in the sheath.

- The second object of the invention is accomplished by adding air introducing means to the above-mentioned filter. Ventilation air is introduced into the passages through the
15 sheath and dilutes the smoke flowing in the passages so that the filter will provide the smoker a milder smoke.

The passages may be provided by longitudinal grooves at the outer peripheral surface of the core and/or the inner peripheral surface of the sheath.

- 20 When the core has the longitudinal grooves, these may be provided by thermoforming the outer peripheral surface of the core or using a corrugated wrapper or a tubular element at the outer peripheral surface of the core; the inner peripheral surface of the sheath may be formed by thermoforming the inner
25 peripheral surface of the sheath or using an outer wrapper surrounding the core. In this case, the passages are defined between the longitudinal grooves of the core and the inner peripheral surface of the sheath. Air permeability may be imparted to both the inner and outer peripheral surfaces of the
30 sheath so that ventilation air flows radially into the sheath and then into the passages.

When the sheath has the longitudinal grooves, these may be provided by thermoforming the inner peripheral surface of

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the sheath or using a corrugated wrapper or a tubular element at the inner peripheral surface of the sheath; the outer peripheral surface of the core may be formed by thermoforming the outer peripheral surface of the core or using a wrapper surrounding the core. In this case, the passages are defined between the outer peripheral surface of the core and the longitudinal grooves of the sheath. Air permeability may be imparted to both the inner and outer peripheral surfaces of the sheath, or air permeability may be imparted to the outer peripheral surface of the sheath and openings formed in the sheath in communication with the longitudinal grooves; in either this case, the ventilation air passes radially into the sheath from outside and then into the passages.

Using a cylindrical corrugated wrapper between the sheath and the core may form the passages between the corrugated wrapper and the sheath and between the corrugated wrapper and the core. In this case, the corrugated wrapper may or may not have air permeability.

The passages may be formed in a tubular element which is arranged between the core and the sheath. Air permeability may be imparted to the inner and outer peripheral surfaces of the sheath, with openings in the tubular element connecting the sheath to the passages.

The passages may have a total cross-sectional area of 1 to 3 mm^2 . In this case, a desirable amount of non-filtered smoke flows in the passages.

The filter may include a cylindrical tip element, which may comprise a filter material. The tip element may have a length from 2 to 20 mm, which is correspondingly 8 to 60 % of the overall length of the filter, and an axial air-flow resistance of 80 or less $\text{mmH}_2\text{O}/25 \text{ mm}$. The tip element makes it easier to adjust the axial air-flow resistance of the whole filter.

The core and the sheath may be made from different materials or the same material. The filter material is preferably tow of cellulose acetate.

5 **Brief Description of Drawings**

FIG. 1 is a perspective view of a filter-tipped cigarette;

FIG. 2 is an end view of a filter;

FIG. 3 is a longitudinal sectional view of the filter of FIG. 2;

10 FIG. 4 is an end view of a filter in accordance with an embodiment 1;

FIG. 5 is a cross-sectional view of the corrugated wrapper of FIG. 4;

15 FIG. 6 is an end view of a filter in accordance with an embodiment 2;

FIG. 7 is an end view of a filter in accordance with an embodiment 3;

FIG. 8 is an end view of a filter in accordance with an embodiment 4;

20 FIG. 9 is an end view of a filter in accordance with an embodiment 5;

FIG. 10 is an end view of a filter in accordance with an embodiment 6;

25 FIG. 11 is an end view of a filter in accordance with an embodiment 7;

FIG. 12 is an end view of a filter in accordance with an embodiment 8;

FIG. 13 is a graph showing the results of a smoking test of a filter-tipped cigarette;

30 FIG. 14 is a graph showing the results of a smoking test of a filter-tipped cigarette;

FIG. 15 is a cross-sectional view showing a modified example of the corrugated wrapper;

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12 and the boundary region 14 have air permeability.

When the core 10 of diameter D and the sheath 12 are made of tow of cellulose acetate fibers, the number N and the overall cross-sectional area of the passages 16 are preferably 3 to 25 and 1 to 3 mm², respectively. The thickness T of the sheath 12 is preferably from 1 to 3 mm. D/T is preferably from 0.7 to 6. The total RTD of the filter 4 is preferably from 80 to 160 mmH₂O, more preferably 105 to 135 mmH₂O.

When the filter-tipped cigarette using the filter 4 is smoked, part of the smoke of the cigarette 2 is directly delivered to the smoker through the axial passages 16. The remaining part of the smoke passes through the core 10 and the sheath 12 and is then delivered to the smoker. The non-filtered smoke locally spreads within the mouth of the smoker. As a result, an adequate feeling of the smoke of the cigarette 2 can be provided to the smoker even if the quantity of non-filtered smoke is small. The smoker therefore can enjoy flavor and scent of the cigarette 2 itself.

Part of the tar and nicotine contained in the smoke passing through the core 10 and the sheath 12 is caught by the filter materials of the core 10 and the sheath 12 so that a mild smoke can be provided to the smoker.

When the outer peripheral surface of the sheath 12 and the boundary region 14 have air permeability, ventilation air is introduced into the sheath 12 through the perforations 8 of the tipping paper 6 during smoking of the filter-tipped cigarette. A part of the ventilation air is further introduced into the axial passages 16 through the boundary region 14. The smoke passing through the axial passages 16 is therefore diluted with the ventilation air, and the smoking feeling is further milder. As a result, the quantity of non-filtered smoke directly delivered to the smoker can be reduced, and the tar and nicotine delivered to the smoker are further reduced.

The amount of ventilation air introduced into the filter 4 through the perforations 8, that is the degree V_f of filter ventilation, is desirably from 30 to 80 % of the total flow (including the smoke of the cigarette 2) sucked by the smoker 5 through the filter-tipped cigarette.

Since the filter 4 has the double structure of the core 10 and the sheath 12, it is possible to independently determine the RTDs and smoke filtering efficiencies of the core 10 and the sheath 12. As a result, degrees of freedom with respect to the amounts of tar and nicotine delivered by the filter-tipped cigarette are increased.

The dilution ratio of the smoke passing through the axial passages 16 can be also controlled by adjusting the RTD of the sheath 12 and the air permeability of the boundary region 14. Further, adjustments of the total opening area of the perforations 8 and the air permeability of the outer peripheral surface of the sheath 12 can also control the dilution ratio. Accordingly, the degree of freedom in the dilution ratio control of the non-filtered smoke can be also greatly increased.

The axial passages 16 of the boundary region 14 can be formed by longitudinal grooves formed at the outer peripheral surface of the core 10 or the inner peripheral surface of the sheath 12. Further, the axial passages 16 can be formed in a tubular element arranged between the core 10 and the sheath 12.

Whilst the non-filtered smoke in the axial passages 16 can be diluted with ventilation air, this is not essential, so that the outer peripheral surface of the sheath 12 and the boundary region 14 are therefore not necessarily air permeable in which case perforations 8 may also be omitted.

Embodiments of the filter will next be explained, in which tow of cellulose acetate fibers is commonly used as the filter material of the core 10 and the sheath 12.

Grooved core type

Embodiment 1

5 In the filter 4 of FIG. 4, tow of the core 10 is wrapped
 in a corrugated wrapper 18. The corrugated wrapper 18 provides
 a corrugated outer peripheral surface to the core 10. The outer
 peripheral surface of the core 10 has therefore a plurality of
 longitudinal grooves 20 extending in the axial direction of the
 filter 4. The number of longitudinal grooves 20 is suitably
 10 4 to 17. The longitudinal grooves 20 suitably have a depth of
 0.15 to 0.45 mm. As shown in FIG. 5, the corrugated wrapper
 18 is preferably made of a laminated paper which may have a
 three-layer structure. For example, the laminated paper has
 a polyethylene layer 18c and pulp layers 18s laminated on both
 15 sides of the layer 18c. The laminated paper can be easily shaped
 into the corrugated wrapper 18 by thermal molding. The
 corrugated wrapper 18 is not limited to laminated paper.
 Various kinds of paper and other materials can be used for the
 corrugated wrapper.

20 An outer wrapper 22 surrounding the corrugated wrapper
 forms the inner peripheral surface of the sheath 12. The outer
 wrapper 22 and the longitudinal grooves 20 define the axial
 passages 16. The outer wrapper 22 preferably has air
 permeability. For example, the outer wrapper 22 can be of
 25 highly porous paper (2000CU, i.e., 2,000 Coresta units).

Tow of the sheath 12 is wrapped in a plug wrapper 24 having
 air permeability. The plug wrapper 24 forms the outer
 peripheral surface of the sheath 12. Plug wrapper for a normal
 filter rod is used as the plug wrapper 24.

30 The RTDs of the core 10 (including the axial passages 16)
 and the sheath 12 in the axial direction of the filter 4 are
 respectively denoted by references P_{CA} and P_S . In this case,
 the ratio $R1 (=P_S/P_{CA})$ is from 0.3 to 4.0 and is preferably about

2.0. For example, when the ratio $R1$ is about 2, tow specifications of the core 10 and the sheath 12 are respectively about 1.7/38000 (i.e., 1.7 filament denier/38,000 total denier; this applies to similar expressions appearing hereinafter unless otherwise specified) and about 5/55000. The tow specifications of the core 10 and the sheath 12 can be respectively selected from a range of 1.5/38000 to 5/17000 and a range of 2.5/45000 to 5/55000.

When the filter 4 of FIG. 4 is manufactured, tow for the core 10 is first wrapped in the corrugated paper so that a core rod is formed. Thereafter, the core rod is further wrapped in the outer wrapper. Tow for the sheath 12 envelopes the outer side of the outer wrapper. The tow for the sheath 12 is wrapped in the plug wrapper so that a filter rod is formed. The filter 4 can be obtained by cutting the filter rod to a predetermined length.

Embodiment 2

In the case of filter 4 of FIG. 6, the outer peripheral surface of the core 10 is formed by thermoforming. The thermoforming forms a plurality of longitudinal grooves 26 on the outer peripheral surface of the core 10. These longitudinal grooves 26 extend in the axial direction of the core 10.

The sheath 12 has an inner peripheral surface formed by thermoforming or a core outer wrapper. The inner peripheral surface of the sheath 12 has air permeability. The inner peripheral surface of the sheath 12 and the longitudinal grooves 26 define the axial passages 16. The outer peripheral surface of the sheath 12 is formed by wrapping tow of the sheath 12 in a plug wrapper 24 having air permeability, or is formed by thermoforming. The filter 4 of FIG. 6 also has the above-mentioned ratio $R1 (= P_S/P_{CA})$.

When the outer peripheral surface of the core 10 or the

inner or outer peripheral surface of the sheath 12 is thermoformed, it has air permeability. For example, the filter 4 of FIG. 6 can be obtained by using the manufacturing technique disclosed in USP 4,022,221, so that the filter 4 has the core 10 with the longitudinal grooves 26 and the sheath 12.

Embodiment 3

In the case of filter 4 of FIG. 7, a tubular element 28 is a boundary region between the core 10 and the sheath 12. A plurality of longitudinal grooves 30 is formed on the outer peripheral surface of the tubular element 28. The tubular element 28 is made of synthetic resin such as polypropylene, polyethylene, etc. or of biodegradable polymer such as acetate, etc.

The sheath 12 has an air permeable inner peripheral surface formed by thermoforming or by an outer wrapper around element 28. The inner peripheral surface of the sheath 12 and the longitudinal grooves 30 define the axial passages 16. A plug wrapper or thermoforming can form the outer peripheral surface 24 of the sheath 12. The filter 4 of FIG. 7 also has the above-mentioned ratio $R1 (= P_S/P_{CA})$.

The filter 4 of FIG. 7 can be manufactured by guiding tow for the core 10 into the tubular element 28 together with extrusion molding of the tubular element 28 and then forming the sheath 12 outside the tubular element 28.

Grooved sheath type

Embodiment 4

In the case of filter 4 of FIG. 8, a corrugated wrapper 32 having air permeability forms an inner peripheral surface of the sheath 12. In this case, thermoforming or a wrapper having air permeability forms the outer peripheral surface of the core 10. The corrugated wrapper 32 is wound around the outer

peripheral surface of the core 10. The axial passages 16 are therefore defined between the corrugated wrapper 32 and the outer peripheral surface of the core 10. Tow of the sheath 12 surrounds the outer side of the corrugated wrapper 32 and
5 thermoforming or the plug wrapper forms the outer peripheral surface 24 of the sheath 12.

Embodiment 5

In the case of filter 4 of FIG. 9, thermoforming forms
10 the inner peripheral surface of the sheath 12 with longitudinal grooves. In this case, thermoforming or a wrapper having air permeability forms the outer peripheral surface of the core 10. The other structural feature of the filter 4 of FIG. 9 are similar to those of the filter of FIG. 6.

In the case of the filter 4 of FIG. 9, the RTDs of the core 10 and the sheath 12 (including the axial passages 16) are respectively denoted as references P_c and P_{SA} . In this case, the ratio $R2 (=P_{SA}/P_c)$ is preferably from 0.2 to 0.4. For example, when the ratio $R2$ is about 0.3, tow specifications of the core
15 10 and the sheath 12 are respectively about 5/35000 and about 7/68000. The tow specifications of the core 10 and the sheath 12 can be selected from respective ranges of 2.8/31000 to 7/34000 and 2.0/36000 to 7/68000.

Embodiment 6

In the case of filter 4 of FIG. 10, longitudinal grooves 30 are formed on the inner peripheral surface of the tubular element 28 and each has a communication hole 34 communicating with sheath 12. The communication holes 34 can therefore guide
25 ventilation air introduced into the sheath 12 into the longitudinal grooves 30. The other structural feature the filter 4 of FIG. 10 are similar to those of the filter of FIG. 7.

Composite type

Embodiment 7

5 In the case of the filter of FIG. 11, thermoforming or
a wrapper having air permeability forms the outer peripheral
surface of the core 10 and the inner peripheral surface of the
sheath 12. A corrugated wrapper 36 is arranged between the core
10 and the sheath 12. The corrugated wrapper 36 forms axial
passages 16 with the outer peripheral surface of the core 10
and the inner peripheral surface of the sheath 12. In this case,
the corrugated wrapper 36 may be air permeable or impermeable.
When the corrugated wrapper 36 is not air permeable, the
non-filtered smoke passing through the axial passages 16 at the
inner peripheral surface of the sheath 12 is diluted with
15 ventilation air, whereas that passing through the other passage
is not. Thermoforming or a plug wrapper forms the outer
peripheral surface 24 of the sheath 12.

Tube type

20 Embodiment 8

In the case of the filter 4 of FIG. 12, a tube 38 is arranged
between the core 10 and the sheath 12 and has the axial passages
16 therein. Similar to the case of the above-mentioned tubular
element 28, the tube 38 is made of synthetic resin such as
25 polypropylene, polyethylene, etc., or biodegradable polymer
such as acetate, etc. Holes 40 in tube 38 give communication
between axial passages 16 and sheath 12. Thermoforming or a
plug wrapper forms the outer peripheral surface 24 of the sheath
12.

30 In this case, the ratio R1 of the RTD of the sheath 12
to that of the core 10 is preferably about 2.0. Tow
specifications of the core 10 and the sheath 12 are respectively
from 1.5/3800 to 5/17000 and 2.5/45000 to 5/50000.

The filter 4 of FIG. 12 is manufactured by introducing tow for the core 10 into the tube 38 together with extrusion molding of the tube 38 and forming the sheath 12 outside the tube 38.

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FIGS. 13 and 14 show the results of a smoking test with respect to a filter-tipped cigarette having the above filter 4.

When there is no air permeability between the sheath 12 and the axial passages 16, the degree $V_F(\bigcirc)$ of filter ventilation hardly changed with change of total RTD of the filter 4, as clearly seen from FIG. 13, and the discharge of tar (\bullet) from the filter 4 is also not changed much. However, when there is air permeability between the sheath 12 and the axial passages 16, the degree $V_F(\square)$ of filter ventilation increases as the RTD of the filter 4 is increased, and the discharge (\blacklozenge) of tar is greatly reduced.

The increase in the degree V_F of filter ventilation means that more ventilation air is introduced into the axial passages 16 through the sheath 12. The non-filtered smoke passing through the axial passages 16 is thus more diluted with the ventilation air. As a result, the amount of the non-filtered smoke delivered to a smoker is reduced and the amount of tar discharged from the filter-tipped cigarette is reduced.

Accordingly, it is desirable to secure the air permeability between the sheath 12 and the axial passages 16 and increase the RTD of the filter 4 so as to reduce the amount of tar discharged. When the RTD of the filter 4 is excessively increased, however, it becomes too difficult for the smoker to draw.

The amount of tar discharged is also greatly changed in accordance with the above-mentioned resistance ratio R. As a result of the smoking test, it is confirmed that the amount of

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tar discharged is increased as the resistance ratio R is increased. This is because the RTD of the core 10 is reduced and the amount of the non-filtered smoke passing through the axial passages 16 is increased so that the tar-filtering effect of the core 10 is reduced.

FIG. 14 similarly shows the relation between the amount of tar discharged, the degree V_f of filter ventilation, and the overall cross-sectional area of the axial passages 16. As clearly seen from FIG. 14, when there is no air permeability between the sheath 12 and the axial passages 16 and the overall cross-sectional area of the axial passages 16 is increased, the degree $V_f(\bigcirc)$ of filter ventilation is reduced and the discharge (\bullet) of tar is increased. In contrast to this, when there is air permeability between the sheath 12 and the axial passages 16, the degree $V_f(\square)$ of filter ventilation is not changed so much and the discharge (\blacklozenge) of tar is gradually increased even if the overall cross-sectional area of the axial passages 16 is increased. The amount of tar discharged can therefore be controlled with high accuracy by adjusting the overall cross-sectional area of the axial passages 16.

Accordingly, in accordance with the filter 4 of the present invention, changing the RTD and the resistance ratio R of the filter 4 and the overall cross-sectional area of the axial passages 16 can control the amount of tar discharged. Further, the degree of freedom of this control is very high. As a result, it is possible to easily obtain a filter-tipped cigarette having an amount of tar discharged equal to or smaller than 3 mg, for example.

According to the result of the smoking test, the ratio of CO to tar (C/T) in the filter-tipped cigarette having the filter 4 is reduced in comparison with a normal filter-tipped cigarette.

As shown in FIG. 15, each of above corrugated wrappers 18, 32 and 36 may be made of charcoal paper in which particles 42 of activated carbon are uniformly distributed in paper material having air permeability. Particles 42 of activated carbon may be uniformly distributed within tow of the core 10 or the sheath 12 as shown in FIG. 16. The particles 42 of activated carbon within the corrugated wrapper, the sheath or the core adsorb vapor phase components in the smoke from the cigarette 2.

The communication holes 40 of the tube 38 of FIG. 12 can be omitted as shown in FIG. 17. In this case, it is impossible to introduce ventilation air into the axial passages 16 in the tube 38 to dilute the non-filtered smoke passing through the axial passages. The filter of FIG. 17 has, however, advantages in that the interior of the filter has the double structure of the core 10 and the sheath 12.

FIG. 17 shows only one example in which the passages 16 are not ventilated. In each of the embodiments of FIGS. 4, 6 to 8, 10 and 11, the inner peripheral surfaces of the sheath 12 and the corrugated wrapper 18 may be air-impermeable, and the communication holes 34 of the tube element 28 can be omitted. Further, when passages 16 are not to be ventilated, the outer peripheral surface of the sheath 12 may be air-permeable in each of the embodiments of FIGS. 4 and 6 to 11, and air permeability of the tipping paper 6 is also not required.

As shown in FIG. 18, the filter 4 may have a tip element 44. For example, the tip element 44 is a so-called plain filter element formed by wrapping tow of cellulose acetate fibers in a plug wrapper 46. The tip element 44 is in close contact with the end face of the filter 4 away from cigarette 2 and has a length from 2 to 20 mm, which is 8 to 60% of the total length of the filter 4 and the tip element 44. The tip element 44 has 80 mmH₂O/25mm as the maximum RTD thereof. It is desirable that

the length of the tip element 44 is as short as possible to retain the original function of the filter 4. However, if the RTD of the tip element 44 is reduced, the length of the tip element 44 can be adjusted for ease of manufacture and assembly with element 44.

The filter 4 and the tip element 44 are connected by connecting paper to form a dual filter. The dual filter is connected to cigarette 2 by tipping paper 6. The connecting paper has air permeability when there is to be ventilation of the filter.

In accordance with the filter-tipped cigarette of FIG. 18, the tip element 44 is added to the filter so that the total RTD of the filter (including the tip element 44) may be controlled by the tip element 44. When particles 42 of activated carbon are included within the core 10 and the sheath 12 of the filter 4, the tip element 44 prevents dropping of the particles 42 of activated carbon.

Further, a plain filter element or a charcoal filter element containing particles of activated carbon can be arranged instead of the tip element 44 between the filter 4 and the cigarette 2. Further, the tip element 44 or the filter element may be respectively arranged at both ends of the filter.

CLAIMS

1. A filter for a cigarette, comprising an assembly of:
a cylindrical filtering core;
a tubular filtering sheath surrounding said core; and,
5 between said core and said sheath,
passages spaced circumferentially around said core and
extending continuously between open ends at the two ends of the
assembly.
- 10 2. A filter according to claim 1 wherein said sheath has a
thickness of 1 to 3 mm, the ratio of the diameter of said core
to the thickness of said sheath is from 0.7 to 6, and there are
3 to 25 of said passages.
- 15 3. A filter according to claim 1 or 2 wherein said sheath
has an axial air-flow resistance higher than that of said core.
4. A filter according to any preceding claim having means
for introducing air into said passages through said sheath.
- 20 5. A filter according to any preceding claim wherein said
core has a plurality of longitudinal grooves at the outer
peripheral surface thereof, and said passages are defined
between the longitudinal grooves and the inner peripheral
25 surface of said sheath.
6. A filter according to claim 5 wherein the longitudinal
grooves are provided by a thermoformed outer peripheral surface
of said core or by a corrugated wrapper or a grooved tubular
30 element at the outer peripheral surface of said core.
7. A filter according to claim 6 wherein both the inner and
outer peripheral surfaces of said sheath have air permeability.

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14. A filter according to any preceding claim wherein the passages have a total cross-sectional area of 1 to 3 mm².
15. A filter according to any preceding claim wherein the assembly is in longitudinal alignment with a cylindrical tip element, said tip element having [a] a length from 2 to 20 mm which is correspondingly from 8 to 60% of the overall length of said filter, and [b] an axial air-flow resistance of 80 or less mmH₂O/25 mm.
16. A filter-tipped cigarette having a filter as claimed in any preceding claim connected to a cigarette by tipping paper having air permeability.
17. A filter for a cigarette, substantially as herein described with reference to the accompanying drawings.
18. A filter-tipped cigarette, substantially as herein described with reference to the accompanying drawings.
19. A filter for a cigarette, substantially as herein described with reference to the preceding embodiments.
20. A filter-tipped cigarette, substantially as herein described with reference to the preceding embodiments.

A filter for a cigarette and a filter-tipped cigarette having a high degree of freedom in control of filtering-efficiency of smoke are provided. The filter has a core 10 and a sheath 12 made preferably of tow of cellulose acetate fibers. A plurality of axial passages 16 is formed between the core and the sheath and extend continuously between both end faces of the filter.

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FIG. 1

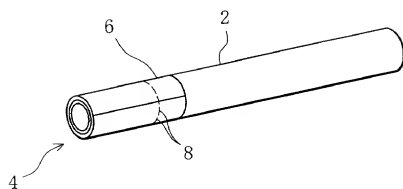


FIG. 2

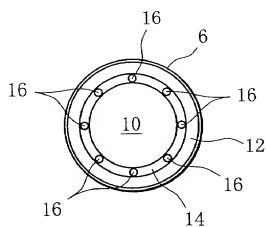


FIG. 3

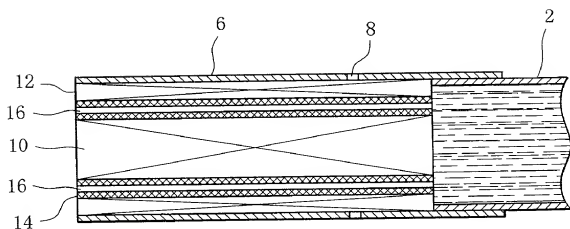


FIG. 4

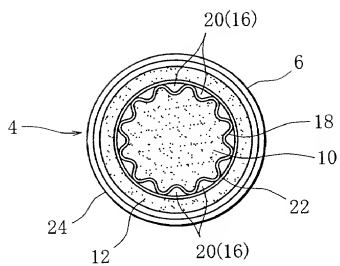


FIG. 5

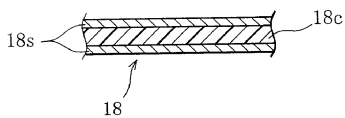


FIG. 6

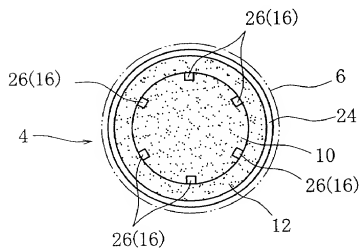


FIG. 7

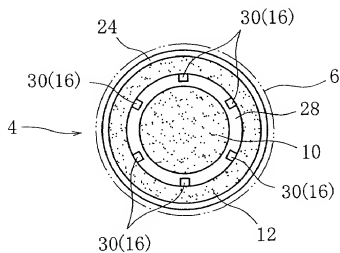


FIG. 8

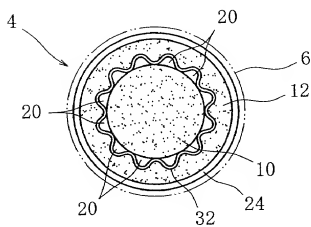


FIG. 9

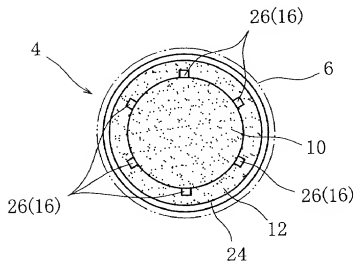


FIG. 10

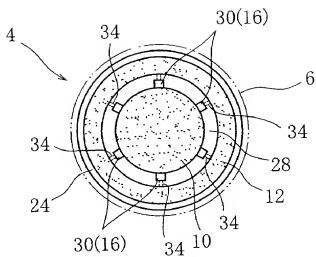


FIG. 11

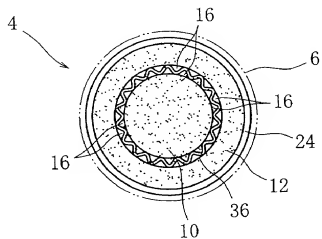


FIG. 12

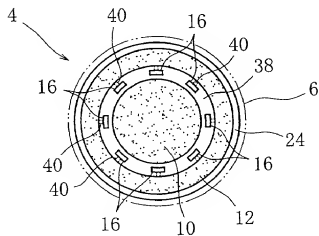


FIG. 13

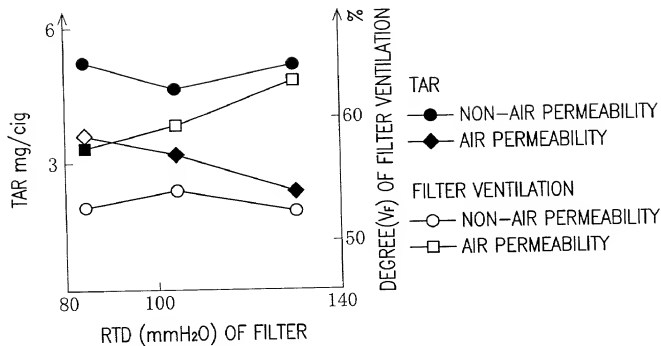


FIG. 14

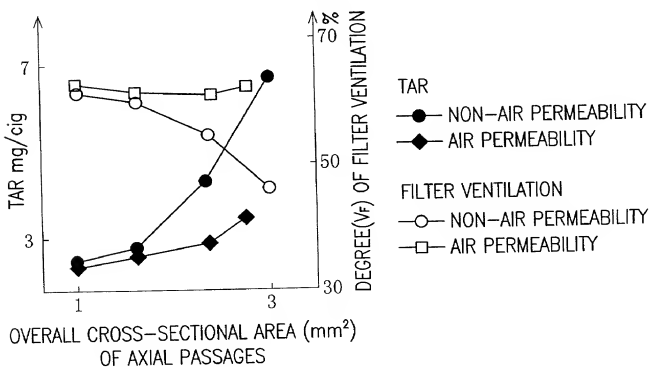


FIG. 15

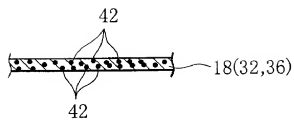


FIG. 16

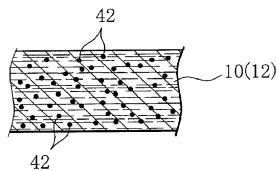


FIG. 17

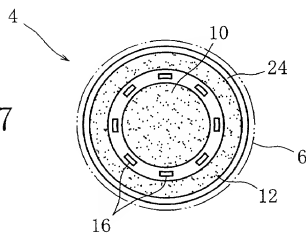
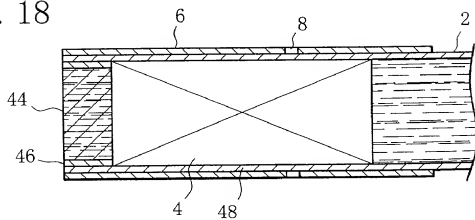


FIG. 18



PLEASE NOTE:
YOU MUST
COMPLETE THE
FOLLOWING:

Insert Title:

FILTER FOR A CIGARETTE AND A FILTER-TIPPED CIGARETTE

Fill in Appropriate
Information -
For Use Without
Specification
Attached:

the specification of which is attached hereto. If not attached hereto,

the specification was filed on _____, as
United States Application Number _____, and /or

the specification was filed on _____, as PCT
International Application Number _____, and was
amended under PCT Article 19 on _____ (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I do not know and do not believe the same was ever known or used in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months (six months for designs) prior to this application, and that no application for patent or inventor's certificate on this invention has been filed in any country foreign to the United States of America prior to this application by me or my legal representatives or assigns, except as follows

I hereby claim foreign priority benefits under Title 35, United States Code, §119 (a)-(d) of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Insert Priority
Information:
(if appropriate)

➔ Prior Foreign Application(s)

<u>9917820.4</u>	<u>United Kingdom</u>	<u>07/29/1999</u>
(Number)	(Country)	(Month/Day/Year Filed)
_____	_____	_____
(Number)	(Country)	(Month/Day/Year Filed)
_____	_____	_____
(Number)	(Country)	(Month/Day/Year Filed)
_____	_____	_____
(Number)	(Country)	(Month/Day/Year Filed)
_____	_____	_____
(Number)	(Country)	(Month/Day/Year Filed)
_____	_____	_____

Priority Claimed

<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
<input type="checkbox"/> Yes	<input type="checkbox"/> No
<input type="checkbox"/> Yes	<input type="checkbox"/> No
<input type="checkbox"/> Yes	<input type="checkbox"/> No
<input type="checkbox"/> Yes	<input type="checkbox"/> No
<input type="checkbox"/> Yes	<input type="checkbox"/> No

I hereby claim the benefit under Title 35, United States Code, §119(e) of any United States provisional application(s) listed below.

Insert Provisional
Application(s):
(if any)

_____	_____
(Application Number)	(Filing Date)
_____	_____
(Application Number)	(Filing Date)

All Foreign Applications, if any, for any Patent or Inventor's Certificate Filed More Than 12 Months (6 Months for Designs) Prior To The Filing Date of This Application:

Insert Requested
Information:
(if appropriate)

_____	_____	_____
Country	Application No.	Date of Filing (Month/Day/Year)

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

Insert Prior U.S.
Application(s):
(if any)

_____	_____	_____
(Application Number)	(Filing Date)	(Status: patented, pending, abandoned)
_____	_____	_____
(Application Number)	(Filing Date)	(Status: patented, pending, abandoned)

I hereby appoint the following attorneys to prosecute this application and/or an international application based on this application and to transact all business in the Patent and Trademark Office connected therewith and in connection with the resulting patent based on instructions received from the entity who first sent the application papers to the attorneys identified below, unless the inventor(s) or assignee provides said attorneys with a written notice to the contrary:

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 FOLLOWING:

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon

Full Name of First or Sole
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 Insert Name of Inventor
 Insert Date This
 Document is Signed

Insert Residence
 Insert Citizenship

Insert Post Office
 Address

Full Name of Second
 Inventor, if any

see above

Full Name of Third
 Inventor, if any

see above

Full Name of Fourth
 Inventor, if any

see above

Full Name of Fifth
 Inventor, if any

see above

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Residence (City, State & Country)		CITIZENSHIP	
POST OFFICE ADDRESS (Complete Street Address including City, State & Country)			

* DATE OF SIGNATURE